A-77

X-ray Microdiffraction Studies of Phase Separation in Complex Oxides

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Structural inhomogenieties in complex oxides range from nanoscale composition or strain fluctuations to macroscopic phase-separated domains and can be strongly coupled with the electronic and magnetic properties. We are investigating phase separation and domain interactions in several complex oxide systems using polychromatic and monochromatic x-ray microdiffraction at APS sector 34-ID-E. Model systems with distinct, relatively large micron-scale phases have been studied as a first step towards understanding nanoscale systems. Directionally-solidified manganite crystals [e.g., EuYMnO and (LaSr)LuMnO] were found to consist of mesoscale lamellar domains with alternating pseudocubic perovskite and multiferroic hexagonal crystal structures. X-ray microdiffraction was used to study the domain orientations, morphologies and interfaces, and to map the local strain fields within the domains. In vanadium dioxide microcrystals, temperature-dependent measurements reveal coexisting monoclinic and tetragonal phases and strain variations near the metal-insulator transition. In all of these studies, the goal is to combine spatially resolved x-ray microdiffraction with other local probes to understand how domain interactions give rise to complex electronic and magnetic properties in strongly correlated oxides.

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